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Black Spot of Roses

BY

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BLACK SPOT OF ROSES

BY

FREDERICK A. WOLF, *Plant Pathologist*

INTRODUCTION

Among the fungus diseases of roses in Alabama, a malady variously designated as; "black spot", "leaf blotch", "leaf spot", etc., is perhaps the most destructive. At least the amount of loss caused is equalled by only one other rose disease, the powdery mildew. This disease is not confined to Alabama together with the territory immediately adjacent, but has been widely distributed throughout the United States. For several years the roses in many parts of Europe, also, have been attacked by this leaf disease which has come to be very severe in certain localities. The fungus, which causes this trouble, is not a new one, having been described[1] for the first time nearly a hundred years ago but seems to have remained a mild parasite until quite recently. In view of the fact that other American investigators have given this disease no special attention, the present purpose is to render availiable, in a concise form, the information[2] at hand relative to its nature and methods of control, together with a few additional observations.

The disease may appear at any time during the season of growth of its host but its destructive nature is not usually manifest until summer. Frequently it continues its ravages during the autumn months until frosts appear. Plants which are attacked become defoliated early in the season and the leaf buds which should remain dormant until the next year, open late in the season. As a result of this premature defoliation the plants are weakened so that they blossom poorly or even not at all in the following year.

DESCRIPTION OF THE DISEASE

The spots produced by the fungus which causes this disease are very characteristic, however there is some chance of their confusion with old stages of the powdery mildew, *Sphaerotheca pannosa* (Wallr.) Lev. and S. *humuli* (D. C.) Burr. They may attain a diameter of a centimeter or more and are more or less circular in

(1) Fries, Elias. Observationes Mycologicae. 207. 1824.

(2) Wolf, F. A. The perfect stage of Actinonema rosae. Bot. Gaz. 54: 218-234, Pl. 23. Sept. 1912.

outline. These spots are characterized by a very irregularly fringed or dendritically fibrillose border and are of a black color (Plate 2) This fibrillose character is due to the rhizomorph-like, radiating strands of mycelium which occur immediately beneath the cuticle. The spots may remain isolated or by confluence involve the entire upper surfaces of the leaves. Often the leaf tissue, adjacent to the portions invaded by the fungus, becomes chlorotic before the leaves fall from the plant. Frequently too, all of the uninvaded tissue becomes yellow before defoliation occurs. When the spots are mature small black pustles, apparent to the unaided eye, are found among the mycelial strands. These are the fructifications of the fungus. They are borne on a very thin subcuticular stroma and exposed by the rupture of the elevated cuticle.

Description of the Fungus

The fungus, *Diplocarpon rosae Wolf*,[2][3] which causes this disease has two stages, a summer or conidial stage and a winter or ascigerous stage, in its cycle of development. The conidial stage is actively parasitic and the ascigerous stage develops saprophytically upon the fallen decaying leaves. This fungus has been known in its conidial condition alone until the publication of some recent investigations (2) (3) by the writer. In this country it has been called Actinonema rosae and in some parts of Europe Marsonia rosae.[4]

The Conidial Stage

The vegetative body of the fungus consists of two parts, the subcuticular mycelium, made up of a net-work of branched radiating strands, and the internal mycelium which furnishes nutriment for the subcuticular part and is connected with it by hyphae which penetrate the epidermal cells or pass between them. A portion of one of these branched subcuticular strands, formed by the union, either side by side or superimposed, of several filaments is shown in Fig. 1. Single filaments are often more or less coralloid in appearance (Fig. 3.) One of these rhizomorph-like strands is shown in vertical section in Fig. 2. It is from the subcuticular mycelium that the fruit bodies or acervuli arise. Their position be-

(3) Wolf. F. A. The perfect stage of the rose Actinonema, Science N. S. 35:151. (Jan.) 1912.

(4) Ducomet, V. Une maladie des feuille du Rosier. Marsonia rosae Br. and Cav. Le Jardin. 199-202 figs. 123-128. 1903.

tween the cuticle and outer wall of the epidermal cells is shown in vertical section in Pl. 1, Fig. 1. At certain definite points on the mycelium a stroma begins to form, increasing in size in a centrifugal manner until a more or less circular stromatic layer has been developed. This stroma, seated directly upon the epidermal cells, consists of a very thin layer of small, clear or faintly yellowish, fungous cells. Certain cells of this stroma which are to bear the conidia are directed upward as short stalks. From these perpendicular stalk cells, a cell is cut off by a transverse septum. This cell enlarges into an oval or elliptical body, the conidium or summer spore, which soon becomes divided by a cross wall. Usually the conidia are somewhat constricted at the septum, sometimes, moreover, so deeply that the two halves separate readily. They are hyaline, straight or somewhat sickle shaped and 18-25x5-6mm. (Pl. 1,fig. 2). As the conidia are increasing in size and number the pressure on the cuticle, which is the only covering for the fruit body, becomes greater and greater, so that it is at length broken and thrown back irregularly, exposing the mass of conidia and permitting them to escape.

During the time that this fructification is being formed the mesophyll tissue below is being disintegrated and replaced by a dense tangle of fungous filaments. While the spots together with the mycelial strands and acervuli appear dark, this color is not due to the fungus, which is almost colorless, but to the disintegration of the leaf tissue below the spot.

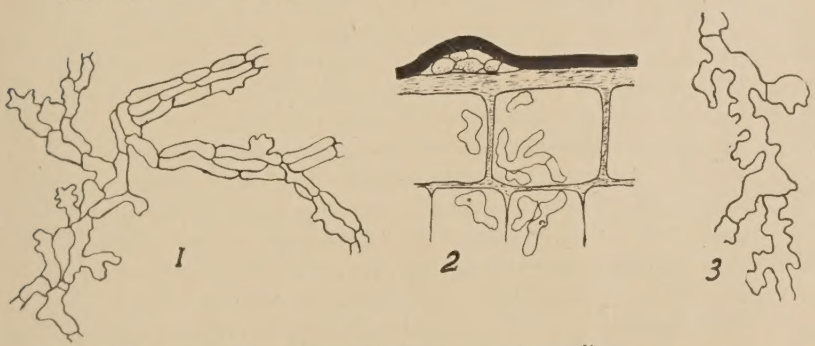

Fig. 1: One of the rhizomorph-like strands of mycelium.

Fig. 2: Vertical section showing the mycelium immediately beneath the cuticle and also within the epidermis and mesophyll.

Fig. 3: A coralloid strand.

Artificial Culture of Conidia

The conidia may germinate within twenty-four hours in bean agar or in drops of water. Each cell enlarges so that the halves become more or less spherical. This is followed by the formation of one or more germ tubes from each of the cells (Pl. 1, fig. 3). Subsequent growth on bean agar is slow and the colonies always remain small. The mycelium is whitish at first, changing to a tawny color and becoming brown to blackish with age. In such cultures conidia may be abstricted from the ends of short mycelial branches. Sterilized bean pods afford a somewhat more favorable medium. Acervuli and conidia very similar to those on rose leaves are developed on this substratum.

The Ascigerous Stage.

The fungus hibernates on fallen rose leaves. By the time that the leaf buds have begun to expand in the spring, the ascigerous fructifications, perithecia, most nearly like those of the Microthyriaceae, have matured. Unopened perithecia are shield-shaped when viewed from above (Pl. 1, fig. 4). Perithecia which have opened are disc shaped (Pl. 1, fig. 5), resembling the fruit bodies of certain Discomycetes. The perithecial shield, which is more or less circular in outline, consists of a thin layer of more or less radiately arranged cells. It varies in diameter from a 100–250 mm. and may not be uniformly one cell in thickness. It is formed immediately beneath the cuticle from the rhizomorph-like mycelium, the cells of which are now thick walled and dark brown in color (Pl. 1, fig. 4). Their point of origin may be any place on the mycelial strand, new cells being developed centrifugally. This shield is separate in origin from the tissue which gives rise to the spore sacs ot asci. Beneath the epidermal cells and above the palisade parenchyma is an undifferentiated layer of fungous tissue which is the stroma from which the asci later arise. This stroma varies in thickness from 3-6 cells and is composed of thick walled cells similar to those of the shield. Occasional filaments, passing through or between the epidermal cells, connect the stroma with the shield. The asci are differentiated within this stroma. By their elongation with the consequent increase of pressure, the cuticle and shield together with the upper part of the apothecium are ruptured and thrown back irregularly (Pl. 1, figs. 5–6). The perithecia vary in shape from spherical to discoid. Mature asci are oblong or subclavate and extend slightly beyond the knobbed paraphyses (Pl. 1, fig. 7). They taper above rather bluntly and

are 70–80 x 15 mm. The ascospores are discharged from an apical pore and pile up in whitish masses in the opened perithecia. They are 20–25 x 5–6 mm., in form resembling the conidia except that they are not so strongly constricted at the septum (Pl. 1, fig. 8). They are hyaline and generally the cells are unequal in size.

Germination of Ascospores.

All attempts to employ artificial media in germinating the ascospores have been unsuccessful. If, however, they are placed in drops of water on living rose leaves, germination can be secured within twenty-four hours. One germ tube, and occasionally two are formed from each cell (Pl. 1, fig. 9). Within eighteen days after inoculation with ascospores, acervuli and conidia will develop.

Susceptibility of the Host

This disease occurs on nearly all of the cultivated varieties of roses, both out of doors and in the greenhouse, but not all are equally subject to attack. Halsted[5] has noted that a wild species, *Rosa humulis,* also, is attacked when growing in the garden with diseased roses. Ducomet[4] calls attention to the fact that *Rosa gallica, R. centrifolia, R. rubiginosa,* and *R. indica* exhibit a marked degree of resistance. Some forms are entirely free from attack. Briosi and Cavara[6] note that only four varieties, *Rosa hybrida var. Bell Angevine, Triomphe d' Alencon, Abel Grant* and *Rosa borboniaria var. Triomphe d' Anger* of the six hundred growing in the botanical gardens at Pavia are free from attack. Laubert and Schwartz[7] point out the fact that the bushy sorts are more susceptible than the climbing varieties, and also that those with thin leaves are most liable to attack.

Methods of Control.

The black spot disease of roses can be successfully controlled by the employment of two methods, (1) sanitation and (2) the application of fungicides. In order to secure the best results the two methods should supplement each other. Since it is now known that the fungus lives over winter on the fallen leaves, it is evident that the severity of the disease may be abated by carefully gathering together all the leaves either late in the fall or early in

(5) Halsted, B. D. New Jersey Agr. Exp. Sta. Rept. 13:281. (1892) 1893.

(6) Briosi, G. and Cavara, F. Funghi parassiti delle piante coltivate od utile. Pavia. N. 97. 1889.

(7) Laubert, L. & Schwartz, Martin. Rosenkrankheiten und Rosenfeinde. 16–19. 1910.

spring before the buds expand. This, at least, lessens the danger of infection, but from experimental work conducted during the past year it is not a sufficient check. Some of the varieties of roses growing at Auburn, Ala., retain their foliage during the entire winter, and the fungus not only lives over winter but thrives in its parasitic on conidial condition. For this reason the plants must be sprayed as soon as the disease becomes manifest, several applications at intervals of a week or ten days being sometimes necessary. Potassium permangnate, made by dissolving the crystals in cold water until a pale rose-red solution is secured, is very efficient but too expensive to be used except in treating a few plants. Any of the standard copper compounds give very satisfactory results. Bordeaux mixture is objectionable in that it coats the foliage. It may be used, however, a few weeks preceding the time for the blossoms to appear. An ammoniacal solution of copper carbonate is just as efficient and lacks the objectionable feature of Bordeaux mixture which has just been pointed out. This solution consists of the following:

Water	15 gallons
Carbonate of copper	2 ounces.
Strong aqua ammonia	1 pint.

A thin paste is first made of copper carbonate and water. The ammonia is slowly added to this and a deep blue solution is obtained, which, if propely made, does not become cloudy as it is diluted with the 15 gallons of water.

SUMMARY

(1) The black spot disease of roses is widely disseminated and very destructive.

(2) The disease has a very characteristic appearance, infected areas being blackish in color and with a fringed border, and results in the defoliation of the plants.

(3) The fungus which causes this disease has two stages, a summer or conidial stage and a winter or ascigerous stage. The summer stage is parasitic and causes a premature defoliation of the plants. The winter stage develops on the decaying leaves and serves to carry the fungus through the winter.

(4) Different varieties exhibit considerable difference in susceptibility, some being readily attacked, others quite resistant, and others entirely free from attack.

(5) The disease may be controlled by the employment of sanitary measures supplemented by the timely application of fungicides.

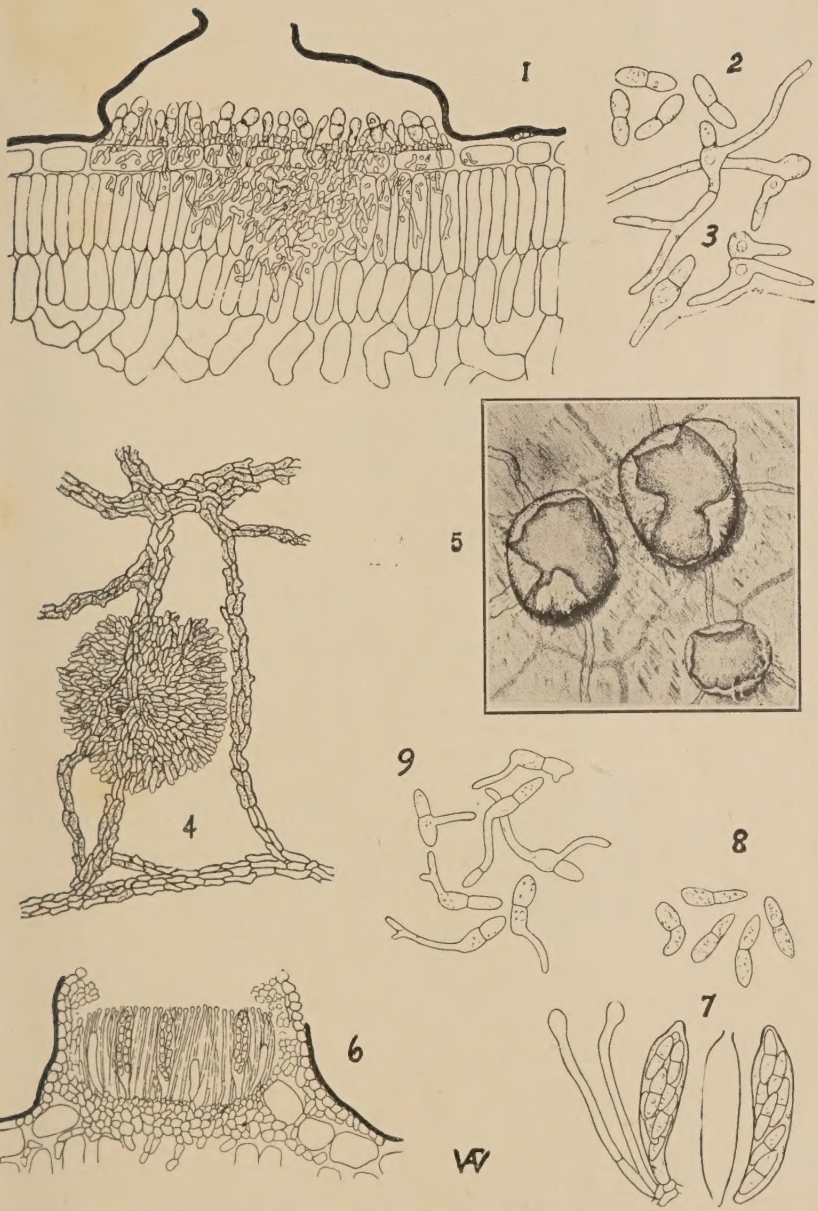

Fig. 1: A vertical section through the acervulus or fruit body of the summer stage. Fig 2: Conidia or summer spores. Fig. 3: Germination of conidia. Fig. 4: Surface view of the ascigerous fruit body showing the shield and strands from which it is developed. Fig. 5: Mature opened perithecia of *Diplocarpon rosae* in which the shield has been ruptured irregularly and folded back. Fig. 6: Vertical section through a mature perithecium. Fig. 7: Asci and knobbed paraphyses. The spores have been discharged apically from one ascus.

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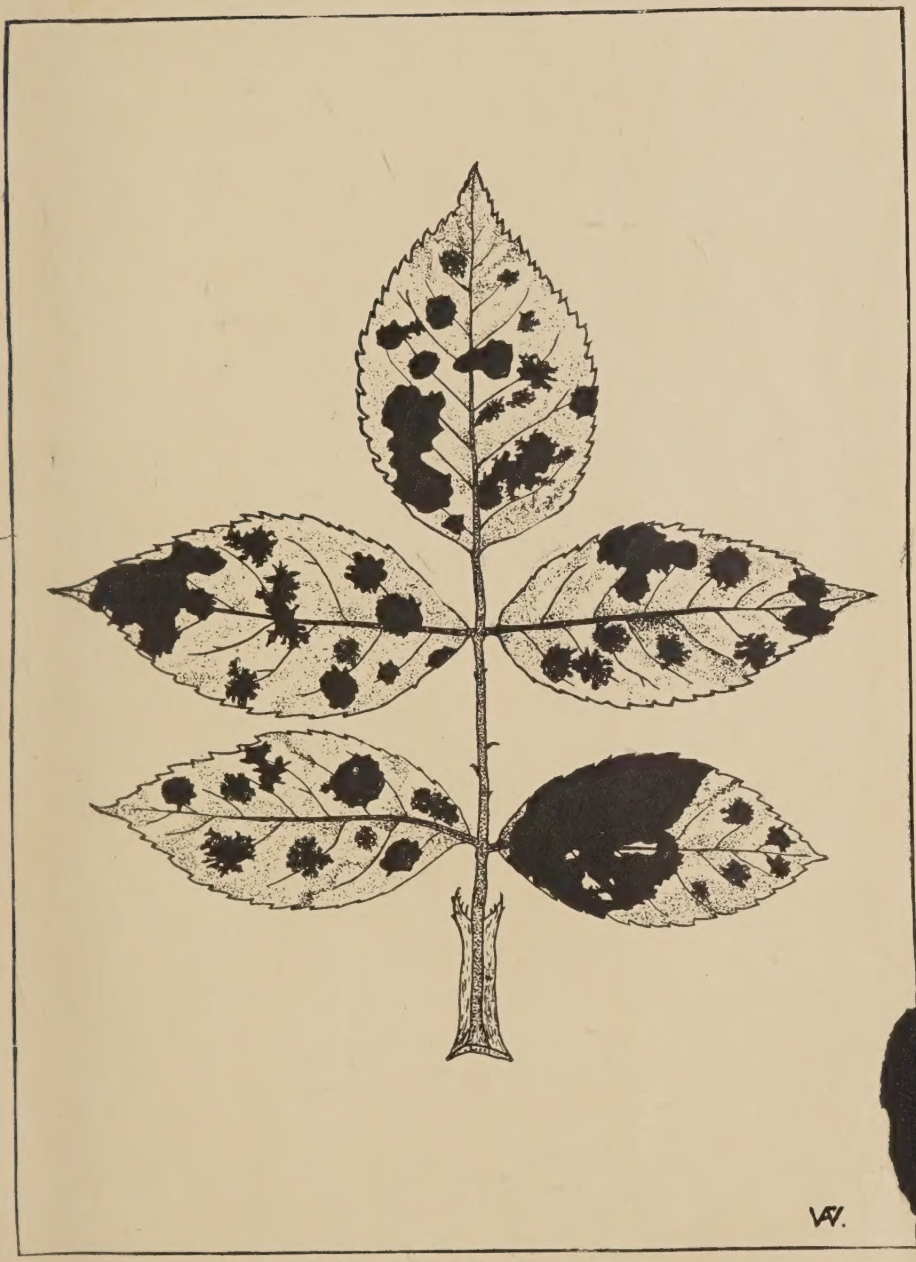

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